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Occupational Musculoskeletal Disorders in Europe:

Impact, Risk factors and Preventive regulations

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Abstract

The aim of this article is to characterize musculoskeletal disorders (MSDs) in EU working population according to available Eurostat data, to identify relevant risk factors and to refer existing legislation and standards to prevent MSDs. The following questions will be answered: How often do MSDs occur in EU? What are the risk factors? Do legislation and standards exist to prevent these disorders?

Introduction

A variety of terms are used to describe musculoskeletal disorders (MSDs). These include repetitive strain injury (RSI), occupational overuse syndrome (OOS) and cumulative trauma disorder (CTD). MSDs include primarily soft tissues disorders of the muscles, tendons, ligaments, peripheral nerves, joints, cartilage, bones and supporting blood vessels (ACGIH, 2001). Upper limbs and neck are the body regions with a highest incidence of MSDs: neck, shoulder, arm, elbow, forearm, hand or wrist. Different abbreviations are used to identify work-related upper extremity musculoskeletal disorders (WMSDs, WRUEDs, WMDs, WRULDs and WRUEMSDs). The disorders may occur in different body regions, as for example in the low back. Different specific MSDs are referred to in the literature: Radiating neck complaints, Rotator cuff syndrome, Lateral and Medial epicondylitis, Cubital tunnel syndrome, Radial tunnel syndrome, Peritendinitis / Tenosynovitis in the wrist region, De Quervain´s disease, Carpal tunnel syndrome, Guyon canal syndrome, Raynaud´s phenomenon, Osteoarthrosis of the elbow, Cervical radiculopathy, Osteoarthrosis of the glenohumeral joint, Frozen shoulder, Thoracic outlet syndrome, Pronator terers syndrome and Trigger finger, among others (Sluiter et al., 2000).

Work-related diseases are multi-factorial in nature and associated to work and non-work factors. The etiologic factors include conditions within the work environment and those associated with the performance of work (World Health Organization, 1985). When MSDs are caused or aggravated by work risk factors, such as repeated or sustained exertions of the

body, and do not result from instantaneous events, they are called work-related musculoskeletal disorders (ACGIH, 2001).

There is still considerable uncertainty and controversy about the extension and aetiology of these problems, multifactorial nature and pathophysiological mechanisms associated to MSDs. However there is adequate evidence for causal relationships between MSDs in several body regions and repetitive motions, forceful exertions, non-neutral postures, vibration and combination of different exposures (ACGIH, 2001). Worker activity produces internal forces acting upon the tissues of the body over time, increasing circulation, local muscle fatigue and other physiological and biomechanical effects. All soft tissues (muscles, tendons, fascia, synovia and nerve) fail when sufficient force is applied, leading to inflammation, muscle fatigue and failure at microscopic level (Buckle and Devereux, 1999).

MSDs in European working population

MSDs represent the most important occupational diseases and work-related health problem in Europe. Two different groups of statistical data can be used to show the impact of MSDs in European population:

- Incidence data: Considering the number of new cases of occupational MSDs in EU (medico-legal diseases), recognised by the national insurance systems.
- Prevalence data: Considering the total number of work-related MSDs, suffered by persons during the past 12 months, caused or made worse by the work. This is a broad concept that covers much more than the occupational medico-legal MSDs: (i) The concept of work-related MSD is based on self-assessment of their work-related state of health by the survey respondents; (ii) It includes complaints irrespective of their severity; (iii) It includes not only health problems caused by work but also those made worse by work.

MSDs represent near 50% of all new cases of certified diseases in EU (Eurostat, 2003) and near 50% of all work-related health problems in Europe (*Table 1*) (Eurostat, 2003a).

Table 1 – Incidence rate of new occupational diseases by group of diseases

Certified occupational disease	Number of new MSDs cases per 100,000 workers exposed
Infections	0.6
Cancers	2.7
Diseases of sensory organs	11.6
Respiratory diseases	7.5
Skin diseases	8.5
Musculoskeletal diseases [1]	31.8
Total diseases	**62.8**

Eurostat. Number and incidence rate (per 100.000 workers) of occupational diseases by economic activity, disease (ICD-10) and sex - EODS obligatory list, 2003 data.
[1] Data includes m00-m99 diseases, g560 Carpal tunnel sdr, and I730 Raynaud´s syndrome

Almost 1:38 workers exposed refers to complaints related to MSDs over the past 12 months (*Table 2*) (Eurostat, 2003a).

Table 2 – Prevalence rate of work-related health problems by group of diseases

Certified occupational disease	Number of work-related health problems per 100,000 workers exposed
Pulmonary disorders	296
Musculoskeletal disorders	2,645
Stress, depression, anxiety	1,181
Other not elsewhere	1,049
Total diseases	**5,372**

Eurostat. Standardised prevalence rate of work-related health problemas by diagnosis group, economic activity of the employer and age (rate per 100.000 workers), 1999 Labour Force Survey.

The number of new (medico-legal) MSDs cases is increasing over time. In 2001, 1:5,100 workers exposed suffered a new (medico-legal) MSD disease. This number almost duplicated in 2003 (1:3,100) (*Table 3*) (Eurostat, 2003c).

Table 3 – Incidence rate of new occupational diseases by group of diseases

Certified MSDs [1]	Number of new MSDs cases per 100,000 workers exposed
2001	19,4
2002	30,6
2003	31,8

Eurostat. Number and incidence rate (per 100.000 workers) of occupational diseases by economic activity, disease (ICD-10) and sex - EODS obligatory list, 2001, 2002, 2003 data.
[1] Data includes m00-m99 diseases, g560 Carpal tunnel sdr, and I730 Raynaud´s syndrome

About 33% of European workers consider that their work affects their health in the form of backache. 37% of all European workers are exposed to heavy loads at least for one quarter of the working time and 12% during all the working time (Paoli and Merllié, 2001).

MSDs according to economic activity

Mining and quarrying, manufacturing and construction have the highest incidence rate in new MSD diseases (medico-legal), and represent 70% of all new MSD diseases reported by EU countries in 2003 (Eurostat, 2003).

However, the prevalence of complaints (irrespective of their severity) related to MSDs is higher at Health and social work, at Transport, storage and communication and at Construction (prevalence in these sectors is 1.2 to 1.6 times higher than average) (Eurostat, 2003a); 1:23 workers in the health and social work refers to health complaints related to MSDs (*Table 4*) (Eurostat, 2003a).

Table 4 – The occurrence of MSDs according to economic activity

Economic activities with the highest exposition to new medico-legal MSDs (Eurostat, 2003a)		Economic activities with the highest exposition to MSDs related discomfort symptoms and complaints (Eurostat, 2003)	
Mining and quarrying	(30.1x average)	Health and social work	(1.6x average)
Manufacturing	(2.5x average)	Transport and communication	(1.2x average)
Construction	(1.6x average)	Construction	(1.2x average)

Both groups of sectors are exposed to high risk factors to MSDs. The consequences of the exposition to the first group of activities are in terms of medico-legal MSD diseases, recognized by the national assurance systems. The consequences of exposition to the second group of activities are in terms of discomfort and complaints related to MSDs, and consequently in terms of interference with work activities.

Some economic activities are particularly exposed to manual handling of heavy loads and consequently to Manual handling related MSDs (as backache) (*Table 5*) (Paoli and Merllié, 2001).

Table 5 – The occurrence of manual handling activities according to economic activity

Economic activities	Percentage of workers exposed to heavy loads (Paoli and Merllié, 2001)
Construction, Agriculture, Fishing	50%
Manufacturing, Mining and quarrying, Transport and communications	25%
Health and social work, Whole sale and retail, Hotels and restaurants	20-25%

MSDs according to occupation

Craft and trade workers, Plant and machine operators and assemblers and Elementary occupations represent 84% of all new medico-legal cases reported in 2003 by EU countries.

Blue colour employees have an incidence rate almost 20 times higher than white colour employees (legislators, professionals and clerks). When compared to Service workers and shop and market sales workers (as for example housekeeping and restaurant, personal care, salespersons and demonstrators) this ratio is only 4 times higher.

The prevalence of MSDs work-related complaints is highest in Service workers and shop and market sales workers and in Elementary occupations (as sales and services elementary occupations, agricultural, fishery and related labourers, labourers in mining, construction, manufacturing and transport) (*Table 6*).

Table 6 - The occurrence of MSDs according to occupation

Occupations with the highest exposition to new medico-legal MSDs (Eurostat, 2003a)	Occupations with the highest exposition to MSDs related discomfort symptoms and complaints (Eurostat, 2003)
Craft and trade workers (3.2x average)	Service workers and shop and sales workers (1.4x average)
Elementary occupations (2.2x average)	Elementary occupations (1.3x average)
Plant and machine operators and assemblers (2.0x average)	Plant and machine operators and assemblers (1.2x average)

Craft and trade workers are more exposed to medico-legal MSD diseases; however Service workers and shop and sales workers are more exposed to discomfort and complaints related to MSDs, and consequently the negative impact in the work activity may be higher in these occupations.

Agriculture workers, craft workers, workers in elementary occupations and machine operators are the most exposed occupations having to move or carry heavy loads. Between 20-27% of these workers have to move heavy loads all the working time and 50-77% at least for one quarter of the working time (2000, EU15)(Eurostat, 2003a). Non-permanent workers (temporary agency and fixed-term contracts) are significantly more exposed to carrying heavy loads (2000, EU15) (Eurostat, 2003a).

Between 1990-2000 there has also been a significant rise in the figures for carrying heavy loads for elementary occupations, plant operators, craft workers and technicians in Europe (2000, EU15) (from 31% to 37% of all EU workers for at least one quarter of the working time, and from 9% to 12% of all EU workers during all the working time) (Eurostat, 2003a).

MSDs according to gender and age

Male workers have a risk 1.3 times higher to new medico-legal MSD diseases than female workers (*Table 7*) (Eurostat, 2003).

Table 7 - Incidence rate of MSDs by sex

Sex	Number of new MSD cases per 100,000 workers exposed [1]
Males	35.4
Females	27.0
Total	**31.8**

Eurostat. Number and incidence rate (per 100,000 workers) of occupational diseases by occupation, disease (ICD-10) and sex - EODS obligatory list, 2003 data.
[1] Data includes m00-m99 diseases, g560 Carpal tunnel sdr, and I730 Raynaud´s syndrome

In the period 2001-03, new cases of Raynaud´s syndrome have been reported only in male workers. However, the incidence of Carpal tunnel syndrome is 3%-7% higher in female workers. The prevalence of MSDs work-related complaints is also higher in Male workers (7% higher) (*Table 8*) (Eurostat, 2003a).

Table 8 – Percentage of workers with work-related MSD complaints

Sex	Percentage workers with work-related MSD complaints
Males	51.7
Females	48.3
Total	**100.0**

Eurostat. Number of work-related health problems by diagnosis group, sex and number of complaints per victim, 1999 Labour Force Survey.

The prevalence of work-related MSD complaints increases with age. At the age 55-64 years it is 1.7 times higher than at the age 25-34 years (*Table 9*) (Eurostat, 2003a).

Table 9 – Prevalence rate of work-related MSDs complaints by age

Age	Number work-related MSD complaints per 100,000 workers exposed
15-24 years	1,457
25-34 years	2,049
35-44 years	2,743
45-54 years	3,399
55-64 years	3,555
Total	**2,645**

Eurostat. Standardised prevalence rate of work-related health problemas by diagnosis group, economic activity of the employer and age (rate per 100.000 workers, 1999 Labour Force Survey, with or without day´s absence from work.

The impact of MSDs in working day´s lost (sick leave) and in workers permanent incapacity

MSDs are the work-related health problem with the highest impact in sick absenteeism; 39% of the workers had a sick leave of 2 or more weeks due to MSDs work related health problems. MSDs are also the work-related health problem with the highest impact in permanent incapacity: 61% of permanent incapacities are due to MSDs (*Table 10*) (Eurostat, 2003a).

Table 10 – Percentage of employed workers having suffered 1 or more work-related MSD during the past 12 months, by severity

Work-related health problem	2 weeks absence or more - % of workers	Permanent incapacity % of workers
Cardiovascular disorders	3.5	10.2
Hearing disorders	1.5	2.3
Pulmonary disorders	4.5	5.0
Musculo-skeletal disorders	38.6	61.1
Infectious diseases	2.3	0.5
Stress, depression, anxiety	18.7	9.8
Skin problems	1.2	1.2
Headache, eyestrain	1.3	0.7
Other not elsewhere mentioned	5.5	4.4
Unspecified	23.0	4.9
Total	**100.0**	**100.0**

Eurostat. Number of work-related health problems by diagnosis group, severity, activity and employment status of the victim and age, 1999 Labour Force Survey.

Almost 43% of the workers, who suffered a work-related MSD in the past 12 months, had a sick leave for less than 1 day. Almost 24% of the workers who suffer from a work-related MSD complaint in the past 12 months, has a sick leave period between 1 and 13 days. Eleven % has a sick leave period between 2 weeks and 1 month and a little more than 20% has a sick leave period for more than 1 month (*Table 11*) (Eurostat, 2003a).

Table 11 – Percentage of employed workers having suffered 1 or more work-related MSD during the past 12 months, by severity

Working days lost	Percentage of employed workers
Less than 1 day lost	42.5
1-3	7.4
4-6	7.5
7-13	8.9
14-29	10.7
1-3 month lost	11.4
More than 3 month lost	9.3
Permanent incapacity	1.7
Unspecified	0.6
Total	**100.0**

Eurostat. Number of work-related health problems by diagnosis group, severity, activity and employment status of the victim and age, 1999 Labour Force Survey.

MSDs more frequent in European workers

Diseases of the musculoskeletal system and connective tissue, as dorsopathies and soft tissue disorders (disorders of muscles, synovium and tendon and of the connective tissue) have the highest incidence rate in new medico-legal MSD diseases. They represent 75% of all reported new medico-legal diseases in 2003. Carpal tunnel syndrome, Raynaud´s syndrome and diseases of the musculoskeletal system and connective tissue are particularly incident in Mining and quarrying activities (*Table 12*) (Eurostat, 2003).

Table 12 - Incidence rate of Carpal tunnel sdr and Musculoskeletal diseases by economic activity

Nace branch	Carpal tunnel sdr Incidence rate (per 100,000)	Raynaud's sdr Incidence rate (per 100,000)	Musculoskelet. system Incidence rate (per 100,000)
a Agriculture, hunting and forestry	2.2	0.2	16.5
b Fishing	6.4	0.0	29.8
c Mining and quarrying	194.6	341.3	422.2
d Manufacturing	14.5	2.3	63.9
f Construction	7.5	3.0	39.1
g Whole and retail trade	3.6	0.2	14.6
h Hotels and restaurants	4.1	0.0	14.7
J Transport, storage and communication	1.5	0.5	10.2
k Real state, renting and business activities	3.9	0.1	13
Total	**5.9**	**2.0**	**23.9**

Eurostat. Number and incidence rate (per 100.000 workers) of occupational diseases by economic activity, disease (ICD-10) and sex - EODS obligatory list, 2003 data.

Craft and related trades workers, Elementary occupations and Plant and machine operators and assemblers are the occupations have the highest risk to carpal tunnel syndrome and musculoskeletal system and connective tissue disorders (1.5-3.3 times the incidence of all MSDs). Plant and machine operators and assemblers have the highest risk to Raynaud´s syndrome (6.8 times the incidence of all MSDs) (*Table 13*) (Eurostat, 2003).

Table 13 - Incidence rate of Carpal tunnel sdr and Musculoskeletal diseases by occupation

Groups of occupations	Carpal tunnel sdr Incidence rate (per 100,000)	Raynaud's sdr Incidence rate (per 100,000)	Musculoskelet. system Incidence rate (per 100,000)
Service workers and shop and market sales workers	3.3	0.0	13.1
Skilled agricultural and fishery workers	4.1	1.3	17.5
Craft and related trades workers	15.8	4.1	80.7
Plant and machine operators and assemblers	16.3	13.6	34.9
Elementary occupations	12.5	1.3	57.0
Total	**5.9**	**2.0**	**23.9**

Eurostat. Number and incidence rate (per 100.000 workers) of occupational diseases by occupation, disease (ICD-10) and sex - EODS obligatory list, 2003 data.

Hand and wrist tenosynovitis, lateral epicondylitis in the elbow and carpal tunnel syndrome represent the medico-legal MSD more incident at work population. They represent 85% of all reported new medico-legal diseases in 2003 (*Table 14*) (Eurostat, 2003).

Table 14 - Incidence rate of Carpal tunnel sdr, Musculoskeletal diseases and Raynaud´s sdr

Musculoskeletal system diseases, Carpal tunnel sdr and Raynaud sdr	Incidence rate (per 100,000)
Hand or wrist tenosynovitis	12.3
Lateral epicondylitis	8.9
Carpal tunnel sdr	5.9
Raynaud's sdr	2.0
Medial epicondylitis	1.1
Other diseases	1.6
Total	**31.8**

Eurostat. Number and incidence rate (per 100.000 workers) of occupational diseases by occupation, disease (ICD-10) and sex - EODS obligatory list, 2003 data.

Factors that may contribute to MSDs

A risk factor to MSDs is any characteristic, condition or behaviour that may cause or aggravate the diseases. Some risk factors to MSDs may exist in the work context (as for example, physical and organizational factors) and others are non-occupational factors (as for example the social context and individual factors).

We may consider four different groups of factors that potentially contribute to MSDs:

- **Physical** or biomechanical work-related factors
- **Organizational** or psychosocial work-related
- **Individual** or personal factors
- The **social context**

The relation between a particular musculoskeletal disease and the work activity is multi-factorial. For example when different physical factors are present and also some organizational, individual and social risk factors coexist, we have a work situation with a high risk to MSDs. To some diseases we have strong evidence on the group factors that may cause the diseases; however, to other diseases we may have a simple evidence or insufficient evidence on that group of factors. Although some discrepancies, there is a broad consensus on the different work factors that may cause or aggravate musculoskeletal diseases.

Physical factors exist in the work procedures, equipment and environment and promote biomechanical stress in the muscles, tendons, discs and some nerves. Force, repetition, extreme postures or long term static postures and vibration are considered the principal physical work-related risk factors to MSDs.

Daily work hours exposed to physical factors and rest or recovery time between those work activities are the principal **organizational factors** to MSDs.

Mental strain can cause muscular tensions and in this sense may increase existing physical strain. Some work conditions that may promote mental strain includes:

- Psychological demanding activities, where the workers are exposed to high levels of work stress, work pressure, and mental demands, as a consequence, for example of tight deadlines, low decision latitude and low autonomy;
- Activities with low social support at work by colleagues, supervisors and company managers.

Individual risk factors as medical history (rheumatoid arthritis, endocrinological disorders, acute trauma) and age may represent a high risk to MSDs. Obesity, pregnancy, force, anthropometrics (dimensions of human body), skills and personality may also have a

impact in MSDs. Some individual risk factors tend to be eliminated at work, by providing workplace that accommodates personal differences.

The social context may represent, in some circumstances, one of the highest risk factors to MSDs. Non-occupational activities, family work at home, insufficient rest hours (as a consequence of the travel distance to work, family responsibilities, work to several employers) are examples of non-occupational social risk factors to MSDs.

Existing legislation and standards to prevent MSDs

Employers in Europe are required to comply with laws and regulations on working conditions and the workplace in their member States. For a large part these laws and regulations are based on European Directives. Some European directives are very important to the prevention of MSDs:

- Council Directive 90/269/EEC on the minimum health and safety requirements for the *manual handling of loads* where there is a risk particularly of back injury to workers;
- Council Directive 90/270/EEC on the minimum safety and health requirements for work with *display screen equipment*;
- 2002/44/EC on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (*vibration*);
- Council Directive 89/391/EEC on the introduction of measures to *encourage improvements* in the safety and health of workers at work;
- Council Directive 98/37/EC on the approximation of the laws of the Member States relating to *machinery*.

In these directives, obligations of employers are described to take preventive organisational measures, to provide mechanical devices, to perform risk assessments and to assess the demands of a specific task. Also, obligations are described to educate workers and to give them the training needed to perform the work in a healthy manner.

Existing standards give detailed technical information concerning the organization of work places and equipments, in order to prevent MSDs. The following list includes relevant standards related to the prevention of MSDs.

- ISO 9241-part 1 to 17:1992 - Ergonomic requirements for office work with visual display terminals (VDTs)
- ISO 11226:2000 - Ergonomics -- Evaluation of static working postures
- ISO 11228-1:2003 - Ergonomics -- Manual handling -- Part 1: Lifting and carrying
- ISO/FDIS 11228-2 - Ergonomics -- Manual handling -- Part 2: Pushing and pulling
- ISO/FDIS 11228-3 - Ergonomics -- Manual handling -- Part 3: Handling of low loads at high frequency
- ISO 14738:2002 - Safety of machinery -- Anthropometric requirements for the design of workstations at machinery
- ISO/TS 20646-1:2004 - Ergonomic procedures for the improvement of local muscular workloads -- Part 1: Guidelines for reducing local muscular workloads
- CEN report PD 12349: 1996 Mechanical vibration - Guide to the health effects of vibration on the human body
- ISO 2631:2001 Mechanical vibration and shock — Evaluation of human exposure to whole-body vibration

- ISO 5349:1986 Mechanical vibration - Guidelines for the measurement and the assessment of human exposure to hand-transmitted vibration. International Organization for Standardization
- EN 14253:2003 Mechanical vibration - Measurement and calculation of occupational exposure to whole-body vibration with reference to health - Practical guidance
- ISO 5805:1997 Mechanical vibration and shock - Human exposure - Vocabulary
- prEN ISO 20643 Hand-transmitted vibration from hand-held or hand-guided machinery - Measurement of vibration at the grip surface (ISO/DIS 20643:2002)
- ISO 8662:1988 Hand-held portable power tools -- Measurement of vibrations at the handle

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Eurostat (2003a), Standardised prevalence rate of work-related health problemas by diagnosis group, economic activity of the employer and age (rate per 100,000 workers), 1999 Labour Force Survey.

Eurostat (2003c), Number and incidence rate (per 100,000 workers) of occupational diseases by economic activity, disease (ICD-10) and sex - EODS obligatory list, 2001, 2002, 2003 data. Data includes m00-m99 diseases, g560 Carpal tunnel sdr, and I730 Raynaud´s syndrome.

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